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Attic Ventilation

From the Editor . . .

There is much discussion today about public resource use, especially in the context of economic stimulation. One action being taken by the new US administration is not just to take care of immediate issues but also a more far-reaching look into the future by funding of research.

Research is one of these areas that requires foresight and investment of time, money and talent with unknown short-term benefits. Although it is not possible to anticipate the results immediately, there are always longer-term benefits and sometimes in a different direction than initially planned. The fact that we have a high quality housing industry, and have even been able take advantage of export opportunities, is the result of research activities, largely but not exclusively, carried out by the National Research Council over many years.

The most successful corporations have been those that give their researchers freedom to do research without short-term goals. Their ramblings have led to significant technological breakthroughs.

As we battle the onslaught of e-mail and spam, or the ubiquitous cell phone, which has now morphed into more than just a phone, we may question if that is really advancement. However, the world in which we live today is the result of massive investments by government, academia and corporations into things that often were not even understood at the time. The esoteric scientific research that only a few geeks in a laboratory might understand can lead to the underpinnings of a new understanding of the world and how it works and leads to innovation and advancement. Even the most obscure scientific advances have had their influence on the more practical aspects of the construction industry.

As I travel around the country, I am amazed how the Internet has changed everyone's life even in small communities. Information access is no longer restricted to those with access to the big city university, library or specialist consultant. It can be available at a moment's notice on that new cell phone at the most remote job site. All this progress is the result of research, which often started with unknown goals at the outset.

In the construction industry we have a problem with research because the industry is not structured in the same manner as vertically integrated industrial corporations that have resources to fund research by amortizing costs across many units of production.

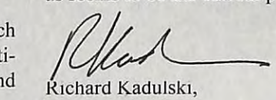
The appliance manufacturer tests a number of items, works out the kinks, and only then puts them on the market – recouping the research costs over the production run. The first microwave ovens cost a lot of money. At one time they were pricey luxury items, but now everyone has at least one. Today we have many similar examples of equipment and appliances whose prices have diminished.

In the residential sector, builders are generally small organizations with limited resources for basic research because work and revenues are project specific. Even a demonstration project, which should offer an opportunity for innovation, becomes a challenge. Incremental costs need to get costed immediately rather than being spread out. Innovation takes extra effort at the outset because it is a learning exercise, yet the builder is expected to take that on during a project with a specific customer. Only the largest production builders are in the situation to be able to make any significant investment in research.

Projects such as the Equilibrium house initiative, which is taking a look at net-zero houses, makes available only modest support for innovation or R&D – at best the money on the table covers a small fraction of the incremental costs. The focus is still very much on market ready or near market ready technologies. These are advanced demonstration homes, rather than opportunities to blue sky research.

That is why publicly funded research, through agencies such as CMHC, Natural Resources Canada, and the Home Owner Protection Office is so important. That is why it is sad to see government cutbacks to research. Even the National Research Council does not have the resources to undertake the research that would be beneficial to the entire industry.

We also need new tools to help the industry with innovation so that testing and R&D can be encouraged and supported without the builder alone having to cover the full costs on a specific project. We need a strong commitment on the part of government to support fundamental research, rather than cutting back on it, as seems to be the current policy.



Richard Kadulski,
Editor

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Illustrations: Terry Lyster
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Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@shaw.ca
Street address:
#204 - 1037 West Broadway
Vancouver, BC V6H 1E3

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Attic Ventilation

Is attic ventilation really needed? New construction techniques, and a better understanding of building performance is raising questions about acceptable attic construction.

The building envelope is subject to wide daily and seasonal temperature swings, large temperature differentials between inside and outside, snow, wind and structural loads, and of course, moisture. The roof is the most exposed part of a building and can be a challenge to designers and contractors.

The building code requires that attics be ventilated. The requirements for attic ventilation have been in various North American codes for many years. They were developed largely by trial and error as the codes evolved, but there has been limited research done into exactly how it works and how much ventilation is required and when.

The National Building Code also says (Section 9.19.1.1) that where it can be shown that ventilation is not required, attic ventilation does not have to be provided. An appendix note states that venting is required to deal with moisture movement because of air leakage, but it also notes that some ceiling assemblies can be built sufficiently airtight that they will not require ventilation. The exception in the Building Code was originally written for manufactured homes that are built under controlled conditions and for which there is a high degree of design and quality control for achieving an airtight ceiling assembly.

Why Attic Ventilation?

The underlying premise behind attic venting is to reduce moisture build-up in the attic that could lead to structural deterioration. The major source of moisture is from the interior – warm conditioned interior air leaking outward.

Warm buoyant air generally leaves the house through the upper part of the house. Because of the stack effect in a building the air pressure differentials drive warm interior air and water vapour outwards and upwards through the building envelope. As air moves through the construction assembly, its temperature, and the amount of vapour it can carry, drops, and moisture condenses on the nearest cold surface, where it can threaten the building assembly's integrity.

In the past, buildings were poorly insulated and there were a few penetrations in the ceiling, so moisture accumulation and condensation in the attic could be expected. Anyone looking into the attic of an older house will see water stains on the structure – evidence of moisture accumulation over time. Air movement through a well-ventilated attic, along with the heat loss through a poorly insulated ceiling, would speed the drying process, reducing the potential for moisture damage.

Today, homes are built differently. Generally ceilings are insulated to much higher levels than in the past, so that attics are much cooler and there is plenty of opportunity for condensation.

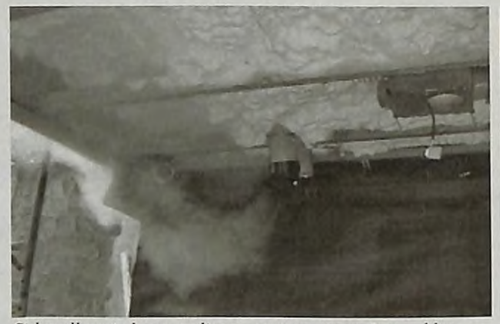
Is Air Leakage A Concern?

Conventional ceiling assemblies rely on a poly-vapour barrier above the ceiling, below the roof structure and insulation. That poly is caulked and sealed so that it also functions as the air barrier. However, poor installation, poly degradation and openings for ceiling fixtures, electrical outlets, plumbing vents, heating and ventilation ducts, etc. compromise the air and vapour barrier and allow moisture-laden air to pass through.

The popularity of recessed ceiling lights provides many ceiling penetrations through which air can leak out of the house. In addition to the ceiling fans, plumbing vents, and electrical wiring penetrations at the ceiling, it is not uncommon to see twenty to forty or more pot lights in a ceiling. The supposedly airtight recessed lights are not particularly airtight, plus there is the matter of wiring, and ceiling finish detailing. As a consequence, there are many air leakage paths, and it is not at all certain that attic ventilation will avoid problems.

We have recently received several reports, especially from the Calgary area, commenting on observed attic moisture. This has been especially pronounced this winter.

One observer noted significant frost build-up on the underside of the roof sheathing. It was identified that the frost was there not because of a leaky exhaust duct from a bathroom fan (or a fan exhausting directly into the attic). Because the roof had been covered with snow, it was attributed to improper attic ventilation because roof vents were blocked with snow, and leakage through improperly sealed ceiling vapour barrier membrane.



Sidewall vented gas appliances represent a major problem to the structure above. The moisture content in the exhaust gases will compromise the building above the vent. This was an installation accepted by the building official – moisture accumulation on the underside of a cold floor can be seen even at this stage of construction.

Other Moisture Sources

Air leakage is not the only moisture source into the attic. Sidewall vented gas appliances generate considerable amounts of moisture, which drifts upward and can enter the attic through soffit venting.

Bathroom and kitchen fans that vent through the wall are another source, although not as important as gas appliances. That is why most building envelope consultants in the Vancouver area want to see soffit vents sealed up in the vicinity above any exhaust hood.

Sidewall vented high efficiency condensing water heater retrofitted into an older home. Vent pipe offset aims to move gas flue away from house, but it is still close enough to be a concern. Moisture could enter attic through soffit vents.

Does Attic Ventilation Work?

The theory behind ventilation is that the moving air will remove the moisture. How well this really works is not known, as there has been little research done. However, we do know that in winter, the drying conditions are not favourable.

Winter outdoor air is typically at or near saturation point since cold air has little capacity to hold moisture. If there is a large airflow through the attic, conditions could actually make the problem worse, as the attic airflow could draw air out of the house, thus pulling more moist air out of the house.

In moist maritime climates, there is potential for seasonal moisture build-up through attic vents, as moist air moves through the attic, depositing moisture as it encounters cooler surfaces in the attic.

The only effective way to reduce condensation in roof and attic spaces is to prevent it from entering in the first place. Moisture penetration can be avoided by installing a continuous air and vapour barrier. That is why it is important to review the quality of the air and vapour barrier during construction.

In the far north, roof systems that rely on venting to purge moisture, such as open attics and ventilated cathedral ceilings, seldom are able to remove moisture before it condenses and turns into frost. In addition, if high winds and fine snow infiltrates the vents, snow can build up in the roof cavities. Any frost or snow in the attic will eventually melt in the spring leading to wet materials and possible structural deterioration.

In the far north, vented attics are now discouraged, in favour of hot roof designs – i.e. insulated, but unvented roof assemblies. CMHC has a publication (***Arctic Hot Roof Design – About Your House,*** North Series, No. 6) to describe these.

Although it may not always be needed, or will not always perform as intended, ventilation of the attic and roof space is still generally appropriate in most situations, and it will help remove moisture or water vapour in those spaces and aid in summer cooling.

Unvented Roof Systems

New construction options are increasingly being looked at for roof assemblies that raise questions about performance and code compliance.

SIPs

For a number of years now, structurally insulated panels (SIPs) have been used with timber frame construction. These are engineered panels that have a plywood or OSB skin on either side of rigid foam insulation. When used on a roof structure, they form the structure and insulation, as well as air barrier and vapour barrier.

Because the SIP is a sandwich panel, they are a roof system that is not vented and it is not needed, in particular when shingles are applied. In the case of sheet metal roofing, a capillary break and drainage layer would be appropriate to deal with sweating of the roof, but that can be accomplished with some of the mesh type products now available for rain screen construction.

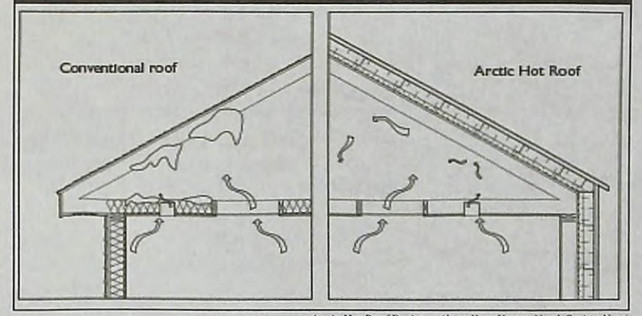
Inverted Membrane Roofs

This is commonly used in commercial construction on 'flat' roofs. In this type of roof, rigid insulation is applied over the principal roofing membrane. Occasionally, this is also seen in single family homes, especially large modern custom homes.

Spray Foam Insulation in Unvented Roofs

Another option that is increasingly being seen is the application of spray foam insulation directly to the underside of the roof sheathing, thus creating an unvented assembly. The spray foam is used not only to provide the required ceiling insulation, but also is the primary air barrier. In many respects, this assembly is similar to a SIP roof, excepting that there is only one skin.

Figure 1—Conventional roof versus Arctic Hot Roof design



Arctic Hot Roof Design – About Your House, North Series, No. 6

When used in a conventional truss or rafter framed roof, the entire attic becomes part of the conditioned space. One concern that has been raised is what happens to the large 'dead' space, and whether it needs to be vented to the interior.

Although the ceiling is 'sealed' and drywall joints are taped, usually there will be quite a large number of penetrations that connect the main portion of the house with the attic space. For example, all pot lights, as well as services that penetrate the ceiling plane (e.g. the wires through the plates, vent stack penetrations, ducts that are run through the attic space) connect the space with the rest of the house.

Their installation must be done with the full knowledge of the foam insulation, so that the pot lights and other ceiling penetrations are treated as interior fixtures to provide a connection to the main portion of the house. Otherwise, it may be wise to introduce either a transfer grille in the ceiling to connect the two spaces, or to add ventilation as part of the whole house ventilation solution. The attic, in this case, is really no different than any other room.

Concerns have also been raised about the durability of foam products because buoyant warm air rises, and can be augmented by heat generated by pot lights. Foam insulation materials are designed as thermal insulation, so are expected to experience a temperature differential across them.

The reason that one often experiences a large temperature difference between the lowest levels of the house and the upper ceiling is because the warm buoyant air rises by convection and escapes the house through air leakage paths in the ceiling. In a standard insulated ceiling, despite best intentions, the many penetrations don't get properly air sealed. As we air-seal the building

envelope, we reduce that air leakage, and consequently the moisture movement out of the main living spaces.

The accumulation of excessive heat at the ceiling can occur in any home. A good design strategy in forced air heated homes would be to consider high return air grilles in any vaulted area – especially if it receives solar heat gain.

Spray foam by its nature is airtight, especially at the thicknesses used to achieve required insulation levels. If there is no air leakage, there will be no moisture movement driven through the assembly.

There is still the issue of vapour diffusion. However, the amount of moisture movement by diffusion is of the order of 1-2% compared to that of air movement. A closed-cell ("2-pound") polyurethane spray foam insulation has a low vapour permeance, and when more than about 1-½ to 2" it meets all the criteria for a vapour barrier. The open cell ("half-pound") spray foam insulation products (such as Icynene or Enertite) still require a vapour barrier, but it should not be poly.

Vapour barrier paints (actually low permeance drywall primers - a latex paint product) can provide the required vapour diffusion protection. This is a fairly standard approach with these paints. If the half-pound foam is covered by drywall (as in a stud wall or in a cathedral ceiling) where the drywall is in contact with the insulation (or within a couple of inches at most) then the paint can be applied directly to the drywall.

What is typically done in locations where the drywall is setback from the foam is to paint the foam. It is applied by spraying it directly on the foam. To ensure there is a proper coverage, the installers may tint the paint so it is visible.

Because the vapour diffusion is controlled, but not stopped, as is the case with poly (poly has a permeance of about 3-6 ng/Pa•s•m^2, while the vapour barrier paint (or the 2-pound foam) gives a permeance in the range of 30-60 ng/Pa•s•m^2) the construction assembly has the ability for a minute amount of drying to take place, so there will not be the likelihood of moisture accumulation because the poly stops all moisture. (That is why you often see moisture in basement framing that has been covered with poly - the poly prevents any drying inward).

Many building components, when subjected to temperature and humidity variation, can change in size. A common question is what happens when expansion, contraction, or shrinkage of building components takes place in a spray foam assembly?

The spray foam products (especially the half-pound foams) generally have enough flexibility to accommodate a small amount of movement. Of course, the application cannot be done until the wood has a moisture content of less than 19% (which is what is required by the building code). The movement of wood at that point is shrinkage, which further compresses the foam, and thus helps seal it, not open it up.

Most foam products can only be applied within certain temperature conditions. Generally, when the temperature of the substrate is sub-zero, the foam cannot be applied (unless the manufacturer has approved it, and it would also be referenced in the CCMC report for the product).

The half-pound foams have a very high expansion rate, and a lower R-value per inch thickness (R3.8/inch), so they will go on very thickly, and can be installed in a single pass. The 2-pound foams have a higher R-value (R6-6.5/inch) and generate a considerable amount of heat when applied, so they can only be applied in 2" lifts - the assembly has to cool before application of subsequent lifts - so to achieve high R-values with 2 pound foam, it may be necessary to schedule an application over more than one day.☼

Continuity of air tightness is critical in an unvented roof. However, the spray foam insulation must remain at least 3 inches from heat emitting sources. Continuity of the air barrier here is maintained by the Iso-board placed behind the pot light, against the roof sheathing, with the spray insulation applied to seal in the Iso board.

What is "Green" Building?

Green building is a holistic approach to building a home that uses less energy, water and natural resources, creates less waste in its construction and is healthier and more comfortable for the occupants.

Green building recognizes that a "house-is-a-system". High-energy performance – i.e. a very energy efficient building envelope construction is a cornerstone of virtually all green building programs – whatever or however they are labelled. And with the increased interest in green and environmentally responsible building, a number of rating programs have emerged.

Regrettably, there is still a lot of misunderstanding about the importance of considering a holistic approach. That is why the Built-Green™ program (and R-2000) requires that builders take a builder course that provides an overview, and background, of building science issues and the house-as-a-system ideas. Hopefully, for most it is a review, and for many, new information is presented.

Most green building programs entail a checklist that lists a range of significant, yet discreet elements that have an environmental impact. Points are given for the use of materials and systems that have been identified as being better and having a lower environmental impact. The entire field of green building materials, suppliers and services is fluid and ever changing. Product availability and suitability is going to vary with location, project type, etc.

Program checklists are described in a way that any knowledgeable builder or designer should be able to understand the requirements. However, there are times when some interpretation is necessary, and for that, help is always available to answer specific questions. Some programs, as has been the case with R-2000 since its inception, require that builders complete training before participating. This ensures that they understand the intent of the program, and can effectively deliver the better built home.

energy conservation of a building is much more important than the embodied energy content of the construction materials

It must be emphasized that green building is not just a matter of picking a number of items off a checklist – it is also their integration into a whole building. The embodied energy content of materials, which is a big part in the evaluation of products for their "greenness" is only a portion of a building's impact on the environment. What is commonly misunderstood is that energy conservation is a much more important aspect of environmentally appropriate construction than whether a material has a low embodied energy or whether it is recycled or not.

The embodied energy content of construction materials – a measure of the energy and resource intensity of materials is often top of mind for most. That is why straw bale construction, rammed earth or cobb construction captures the imagination – use of materials with a very limited amount of offsite manufacturing. However, the embodied energy content is a small part of the energy that goes into a building. What is often disregarded is the energy consumption of the building over its lifespan, which will be many times the embodied energy of construction materials.

A good green building program will provide builders and designers with the maximum amount of flexibility, rather than dwelling on specific products or technologies. It should provide the designer or specifier the tools to help them evaluate their options.

R-2000

For information on the R-2000 Program, contact your local program office, or call
1-800-387-2000
www.R-2000.ca

Green Building Checklist Topics

Typical issues that are covered in green building programs are listed here. The specifics, and their weighting will vary with the program.

Energy Efficiency
- ✔ Must meet specific energy performance targets (e.g. a minimum EnerGuide Rating, or an energy target)
- ✔ Operational systemsMechanical equipment and systems

Building materials
- ✔ Advanced framing
- ✔ Resource efficient engineered products
- ✔ Recycled content in materials
- ✔ Locally produced materials

Interior and Exterior Materials
- ✔ Finishing materials with recycled content
- ✔ Local materials
- ✔ Durable finishes

Indoor Air Quality
- ✔ Air filtration
- ✔ Low-emissions materials

Ventilation
- ✔ Ventilation systems
- ✔ HRVs

Water Conservation
- ✔ Water conserving fixtures
- ✔ Water efficient landscaping

Business Practices
- ✔ Builder's commitment to green building
- ✔ Builder's environmental plan

It must also be remembered that what is important in one region is not the same in all other parts of the country. The differences may be influenced by local climatic conditions, local economy, availability of resources, etc. For example, the LEED for Houses program that has been launched by the Canada Green Building Council, is an adaptation of the LEED for Houses program developed in the US. The US LEED rating has a big focus on cooling, air conditioning and water efficient landscaping issues, which is not unexpected since a lot of new construction has taken place in the US sunbelt where that is a very important concern. However, in many parts of Canada, the need for air conditioning is a sign of poor design, since much of Canada does not really have a climate where cooling is needed, so the Canadian version has had to downplay the importance of cooling. ☼

LEED Canada for Homes Launched

The Canada Green Building Council (CaGBC) has launched its new green building program: **LEED® Canada for Homes**. It is an initiative designed to promote the transformation of the mainstream homebuilding industry toward more sustainable practices. CaGBC is targeting the top 25% of new single-family homes with best practice environmental features.

LEED® Canada for Homes is a rating system that promotes the design and construction of high-performance green homes that use less energy, water and natural resources, creates less waste, and are healthier and more comfortable for their occupants.

While CaGBC recognizes that there already are a number of local or regional green building programs, they are attempting to provide national consistency to define the features of a green home and to enable builders anywhere in the country to obtain a green rating on their homes.

LEED® Canada for Homes is an adaptation of the US Green Building Council's LEED for Homes program which is a points-based rating tool. The minimum number of points for certification is 45, for Silver it is 60, Gold 75, and Platinum 90. The maximum number of points possible is 136. Given the point distribution, and the original bias to southern locations, not all points will, in practice, be available to all projects in Canada.

Recognizing that the size of a house is also important for its environmental impact, the

Continued on page 9

The LEED® Canada for Homes Rating System measures the overall performance of a home in eight categories. There are a number of mandatory measures that must be done, and they will provide 19 points.

Innovation & Design Process: Points for special design methods, unique regional credits, measures not currently addressed in the Rating System, and exemplary performance levels. *11 points available (3 points for mandatory measures)*

Location & Linkages: Points based on the placement of homes in socially and environmentally responsible ways in relation to the larger community. *10 points available*

Sustainable Sites: Points for how the entire property is developed, so as to minimize the project's impact on the site. This is where low impact landscaping is rewarded. *22 points available (2 points for mandatory measures, minimum 5 required)*

Water Efficiency: Water-efficient practices, both indoors and outdoors. *15 points available (1 point for mandatory measures, minimum 3 required)*

Energy & Atmosphere: Energy efficiency of the house, particularly in the building envelope and heating and cooling design. Minimum energy performance requirements are spelled out, using either the US HERS rating system (which has extremely limited capacity to deal with Canadian locations) or a minimum EnerGuide Rating of 76. *38 points available (2 points for mandatory measures, no minimum)*

Materials & Resources: Efficient use of materials, selection of environmentally preferable materials, and minimization of waste during construction. *16 points available (3 points for mandatory measures, minimum 2 required)*

Indoor Environmental Quality: Improvement of indoor air quality by reducing the creation of and exposure to pollutants. *21 points available (7 points for mandatory measures, minimum 6 required)*

Awareness & Education: Points for the education of the homeowner, tenant, and/or building manager about the operation and maintenance of the green features of a LEED home. *3 points available (1 point for mandatory measures)*

Home Size Adjuster: modifies points required based on the size, to a maximum ±10 points. For example, a larger 3-bedroom house with a +5 point adjustment factor would require a minimum of 80 points for Gold rather than 75 points which is the Gold level, while a smaller 3-bedroom house with a -5 adjustment factor would only require 70.

Radon measurement

Radon is a radioactive gas with the potential to cause lung cancer. Recognition that this is an important environmental contaminant that merits attention is based on recent studies in Europe and North America that have found that a larger number of lung cancer deaths can be attributed to long-term radon exposure. As a result of the new scientific findings, Health Canada lowered the federal indoor radon guideline for dwellings to 200 Bq/m^3. And more Canadian houses will experience conditions that will be above the federal guideline.

Not everyone exposed to radon will develop cancer. The time between exposure and the onset of the disease is usually many years. Unlike smoking, occasional exposure to radon does not produce symptoms such as coughing or headaches.

A detailed radon frequency map is not available, nor it likely to be for some time. What is known about radon concentrations is that it is highly variable, so even two identical houses side by side could experience significantly different levels.

Because radon is radioactive, as it decays it produces decay products, referred to as "radon daughters" or "radon progeny". The airborne radon gas and radon progeny can be breathed into the lungs where they break down further and emit alpha particles, which release small bursts of energy that are absorbed by the lung tissues. This results in lung cell death or damage. When lung cells are damaged, they have the potential to result in cancer when they reproduce.

The US has had robust radon remediation activity for many years. Radon testing and remediation started after a nuclear industry worker triggered, by accident, the radon monitors located at the entrance to nuclear facilities – except that the worker was coming into work from home, and not leaving the plant. It was discovered that his house had high radon levels.

Awareness of radon is likely to increase among Canadians over the next several years. Health Canada, Canada Mortgage and Housing Corporation (CMHC) and other agencies are starting to provide more information on how to test for radon, how to remediate houses that have high radon levels and what areas of the country are most at risk.

Unpublished fact-finding tests of homes in several locations across Canada indicate that homes in all parts of the country could have high enough concentrations to merit remediation. The only part of the country that doesn't see high radon levels is the West Coast, even though the interior of BC does experience high radon incidences.

Radon Monitoring

The first and most important step to deal with radon is to perform a radon test. What is important to understand is that the test is not something that can be done at a moment's notice. It is not like a blower door test to measure how airtight the house is, or an air test to identify the presence of contaminants in the house. Rather, it requires a test done over a long term – ideally three months or more, because radon levels can fluctuate quite widely.

The variability of radon levels was observed when a home in Kanata, on the western edge of Ottawa was monitored. Figure 1 shows a month of radon readings in the basement. The dashed line is the 200 Bq/m^3 which represents the recommended guideline. As can be seen, the concentration fluctuates due to house operation, climate factors, and so on. A short reading over two days could give a reading as low

Tests shorter than 48 hours are never acceptable to determine radon concentrations for purposes of assessing the need for remedial actions.

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LEED rating system has a size modifier. The home size adjustment penalizes larger homes, and credits small homes. However, the entire conditioned space is used in calculating floor area, so that a 1200 sq.ft. bungalow on a full basement is considered to be a 2400 sq.ft. house. The bedroom count is the defining element, with the neutral point being 2200 sq.ft. for a 3-bedroom home. The more bedrooms in the house, the larger it can be before it gets penalized.

Unlike R-2000, Built-Green™ and Energy Star in Saskatchewan and Ontario, there is no mandatory training required. Rather, the expectation is that the third party service provider will give the support and necessary training to the builder.

Information: *www.canadagreenhomeguide.ca*

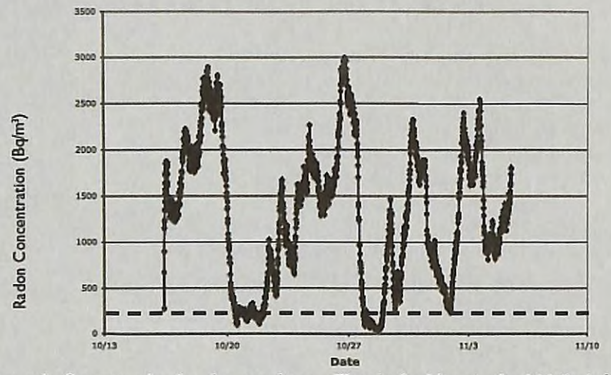


Figure 1. One month of radon readings. The dashed line is the 200 Bq/m³ level that represents the new guideline. Significant number of readings above this level mean excessive radon readings in this home, and for which remediation is recommended.

as 150 Bq/m³ or as high as 2,700 Bq/m³. That is why ***Radon: A Guide for Canadian Homeowners*** recommends that houses be tested for no less than one month, but preferably longer.

In the Kanata home, the results averaged over the test period were in the range of 1,400 Bq/m³, well above the new or old guideline, and appropriate for remediation. The basement had poured concrete floor and walls, and was not different from neighbouring houses. The basement floor slab was poured on polyethylene sheeting, which should reduce the radon entry rate.

Long-Term Measurements

As the Kanata test showed, radon levels in a home can change by a factor of 2 to 3 over a 1-day period and variations from season to season can be even larger. The highest radon levels are usually found during the winter. That is why a long-term measurement period will give a much better indication of the annual average radon concentration than measurements of shorter duration.

Health Canada recommends that radon testing be done over a longer term, typically over 3 to 12 months. During this time there are no requirements for the occupants to change their life-style when the measurement devices have been put in place. Health Canada does not recommend a test of duration less than 1 month.

Short-term measurements – less than 3 months (or as short as 2 to 7 days) – can be done, however, such short-term measurements need to be used with caution. Tests shorter than 2 days (48 hours) are never acceptable to determine radon concentrations for purposes of assessing the need for remedial actions.

Since radon concentrations vary over time, any short-term measurement should be confirmed with a "follow-up" long-term measurement regardless of the initial measurement result.

Short-Term Measurements

Short-term measurements (less than one week) must be made under closed-building conditions to stabilize the radon concentrations and increase the validity of the annual radon concentration estimate. The building needs to be prepared and closed during the measurement. The conditions should be in place for 12 hours before starting and during the test which would last up to one week. Closed-building conditions mean:

- ✔ All windows and exterior doors need to be kept closed for the duration of the test. Normal entry and exit into the house, including a brief opening and closing of a door will not upset the test, but outside doors should not be left open for more than a few minutes.
- ✔ High-volume, whole-house and window fans should not be operated. However, attic fans intended to control attic temperature or humidity may be operated. Combustion or furnace makeup air supplies must not be closed.
- ✔ Normal operation of heat recovery ventilators (air-to-air heat exchangers) can continue. In houses where permanent radon mitigation systems have been installed, these systems should be functioning during the measurement period.
- ✔ Systems that recycle interior air can be operated during the closed-building conditions.

Short-term tests lasting less than four days should not be done during stormy weather or periods of unusually high winds. The quick barometric pressure changes associated with storms increase the chance of fluctuations in the interior and exterior air pressures, and consequently the rate of radon influx. The radon concentration during the measurement may not be representative of the average concentration in the building.

Ideal closed-building conditions generally happen during the cold season from October to April when the average daily temperature is low enough that windows are kept closed.

The result of any short-term measurement (regardless of the result) should be confirmed with a follow-up long-term measurement. The follow-up measurement should be made at the same location as the initial measurement.

Measurement Locations

To provide a realistic estimate of the radon exposure of the occupants, all measurements should be made in the lowest lived-in level of the home. The normal occupancy area is considered to be any area occupied by an individual for more than 4 hours per day. This could include family rooms, living rooms, dens, playrooms and bedrooms.

A lower level bedroom is preferred because people generally spend more time in their bedrooms than in any other room in the house. Similarly, if there are children in the home, lowest level bedrooms or other areas such as a playroom are preferred.

- ✔ The best location for the detector is by an interior wall 3 to 6.5 feet from the floor, away from the ceiling and objects that might impede airflow around the detector, and about 16 inches from an interior wall or 20 inches from an exterior wall.
- ✔ Measurements should not be made in kitchens or laundry rooms.
- ✔ Measurements should not be made in bathrooms as the high humidity may affect some measurement devices, and an exhaust fan may temporarily alter radon concentrations.
- ✔ The detector should be kept away from air currents caused by heating, ventilating and air conditioning vents, doors, fans and windows. They should not be placed on or near electrically powered equipment or appliances such as the tops of televisions, stereos or speakers.

Interpreting the Results

If the long-term measurement results are less than 200 Bq/m³, the average annual concentration in the home is probably below 200 Bq/m³. More measurements are not necessary and remedial action is not recommended.

If the long-term measurement results are more than 200 Bq/m³, then the average annual concentration in the home or building is probably above 200 Bq/m³ and remedial action is recommended. If the average is more than 600 Bq/m³, the remedial action should be done within a year.

Proposed Building Code Changes

Proposed changes to the National Building Code recognize that predicting potential radon concentrations is not possible, nor is it possible to do a test when the house is being finished. That is why the proposed changes will not set out specific requirements, but rather make it easier for homeowners to retrofit radon remediation measures should testing discover higher radon concentrations. An appendix note will state that long term testing by the homeowner is required to identify whether radon remediation is required.

The principal requirements that will be proposed are to air seal the foundation, have porous material under the foundation (i.e. a crushed rock base under the foundation) and a sealed, marked pipe stub that can be extended to the exterior.

The most effective radon remediation approach used to reduce radon levels in buildings is to depressurize the ground under the house. This requires the installation of a pipe that collects air from below the building. A small quiet fan continuously pulls the air from under the house to the exterior.

More information:
http://hc-sc.gc.ca/ewh-semt/radiation/radon

Radon: A Guide for Canadian Homeowners (a joint CMHC/Health Canada publication) available for download at:
www.cmhc- schl.gc.ca/odpub/pdf/61945.pdf

Canadian Home Builders' Association

Technical Research Committee News

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.
Canadian Home Builders' Association, Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca
www.chba.ca

Certification of Pressure Treated Wood

The Building Code requires that structural wood used in residential construction be treated where it is:

- in ground contact,
- within 450 mm of the ground in areas known to have termites,
- supported on moisture permeable materials within 150 mm of the ground,
- subject to prolonged exposure to moisture in locations where the moisture index is greater than 1.00,
- used in permanent wood foundations, and
- used in retaining walls or cribbing that contributes to the stability of the foundation or where retaining walls or cribbing are greater than 1.2 m in height.

There are four residential Product Groups:

A – 1" (25 mm) or thinner pieces used where the potential for decay is low.

B – wood between 1" and 1-½" (25 mm and 40 mm) thick and less than 6" (150 mm) wide used where the potential for decay is low or where the member does not provide structural support for another member.

C - structural lumber thinner than 1-½" (40 mm) used as supporting members in UC3 exterior applications.

D – posts and timbers used in ground contact applications.

A national program is now in place for the treatment, inspection and application of a certification mark for pressure treated wood produced to CSA standards as specified in the National Building Code of Canada. The program is provided by the Canadian Lumber Standards Accreditation Board (CLSAB).

Pressure treated wood produced under the national certification program will be marked with an end tag showing the preservative used, the use category, the product group and a plant identification number. Pressure treated wood used in permanent wood foundations will be marked with an ink stamp.

The label will show the certification mark of a CLSAB accredited inspection agency, verifying that the wood has been treated in compliance to the applicable CSA treatment standard and that all quality assurance inspection procedures have been followed. ☼

Typical applications			Nominal lumber sizes	CSA 080-97 Standard	Residential Group Type	Preservative type	Service condition
Above ground	Interior	Interior construction sill plate, floor & roof framing	2x4, 2x6, 2x8	080.34 080.2	N/A	Borate ACQ-C ACQ-D CA-B	Interior construction damp
	Exterior	Exterior Decks, railings	2x2, 2x4, 2x6	080.36	B	ACQ-C ACQ-D CA-B	Exterior construction subject to prolonged wetting
		Deck joists, beams	2x8 & deeper	080.2	C		
Ground contact		Deck support & guardrail posts	4x4, 4x6, 6x6, 8x8	080.2	D	ACQ-C ACQ-D CA-B	Exterior construction, ground contact
Certification based on the CSA O80 Series of Standards - Wood Preservation - published in 2008.							

Information: www.woodpreservation.ca

Plumbing Products That Do Not Meet Standards

The Canadian Institute of Plumbing and Heating (CIPH), in conjunction with provincial/territorial plumbing inspectors, has issued an industry bulletin on the distribution and installation of plumbing products that do not meet applicable standards.

Uncertified products are being inappropriately sold and installed in all jurisdictions of Canada. In many cases, this is creating health and safety issues.

Myths and Realities about uncertified products

Myth: All plumbing products sold through the retail chain are suitable for sale and installation.

Reality: If a product has a Canadian or a harmonized US - Canadian standard that it can be certified to and it is not certified, it may cause health and safety concerns, including damage to the building it is being installed in.

There are some plumbing products (i.e. certain water treatment devices) that may not have a standard to which they can be certified. These products are an exception to the rule and are permitted for sale and installation.

Myth: Installing uncertified plumbing product does not violate any provincial/territorial regulations.

Reality: No jurisdiction in Canada allows uncertified product to knowingly be installed. Alberta and Quebec both have legislation against the sale of such products (with the exception of products that do not have a standard to which they can be certified).

How do I know if a product is certified?

There are several certification organizations that are accredited to certify product in North America. The certifying body is required to ensure their mark is placed on product it certifies.

What's the harm in stocking and selling uncertified fixtures/fittings?

In Alberta and Quebec it is a crime and is enforceable by law. In other Canadian jurisdictions it may not be considered criminal activity to sell the products, but provincial regulations forbid their installation. This means that anyone stocking and selling uncertified products can expect to have them disallowed by provincial/municipal inspectors. Also, there is no assurance that uncertified fixtures/fittings meet Canadian recognized standards or where standards do not exist, meet reasonable expectations for performance, health and safety.

What if a fixture manufacturer has their product certified, but has not marked the product?

Certified product is required to bear the certification mark. Some customers want a fixture without any labels so manufacturers may mark their product with a permanent adhesive label that is designed to be removed after inspection and is also designed to self-destruct so that it can't be placed on another product. If the permanent adhesive label is accidentally removed prior to inspection, the inspector has no choice but to assume the product is uncertified and request its removal.

Customers need to keep the proof of a products' certification compliance on the product (in addition to the carton, installation instructions, warranty and homeowner's manual and specification sheet) until AFTER inspection.

If I see a mark that I think is questionable, how do I verify if the product is acceptable?

All accredited certification organizations in North America have a webpage that includes certified product directory listings. They can be accessed to verify if a given product is listed:

BNQ: *http://www-es.criq.qc.ca/pls/owa_es/bnqw_entr_enr.crit_rech?p_lang=en&p_type_bnq=NC*
CSA: *http://directories.csa-international.org/*
IAPMO: *http://pld.iapmo.org/*
Intertek: *www.intertek-etlsemko.com*
NSF: *www.nsf.org*
QAI: *www.qai.org*
UL & ULC: *www.ul.ca*
Water Quality Association: *www.wqa.org*

The bulletins are available on CIPH's website in both French and English: *www.ciph.com*

Finger-Jointed Grade Stamp

Finger-jointed lumber (FJL) is a widely-used product that has been in production for more that twenty years. Its popularity can be attributed to several factors, including:

- straightness and dimensional stability,
- interchangeability with solid-sawn lumber in approved applications,
- availability in longer lengths, and
- efficiency in wood fibre use.

Finger-jointed lumber is manufactured by taking shorter pieces of lumber, machining a "finger" profile in each end of the short-length pieces, adding an appropriate structural adhesive, and pressing the pieces together to make a longer piece of lumber.

In finger-joining, the length of a piece of lumber is not limited by log size, and the process may result in the production of products in lengths of up to 60 ft.

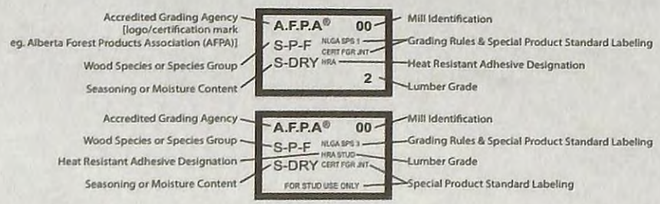
The finger-jointing process allows the removal of grade-limiting characteristics, such as large knots, and combines the pieces to produce a lumber product with stronger engineering properties.

There are two main categories of finger joints in lumber, depending on the intended end-use. The first category has finger joints that allow the product to be used in either vertical or horizontal load applications, in sizes up to 2x12 and up to 31 feet long.

The second category of finger joint limits the product for use as vertical framing members, to carry vertical loads. Finger-jointed "Vertical Stud Use Only" lumber (previously known as "Stud Use Only") is produced in sizes 2" x 2" through 2" x 6" only, and in lengths up to 12 ft.

Although they may be manufactured in any species, finger-jointed lumber products are most commonly available in Spruce-Pine-Fir (SPF), Hemlock-Fir (Hem-Fir (N)) and Douglas Fir-Larch (D Fir-L (N)). "Stud" and "No. 2" are the most widely available grades, although other grades may also be produced.

More information: *Quick Facts - Product series - Visually-Graded Finger-joined Lumber*. Canadian Wood Council – *www.cwc.ca*


Accredited Grading Agency [logo/certification mark eg. Alberta Forest Products Association (AFPA)]
Wood Species or Species Group
Seasoning or Moisture Content
A.F.P.A® 00
S-P-F NLGA SPS 1 CERT FGR JNT
S-DRY HRA
2
Mill Identification
Grading Rules & Special Product Standard Labeling
Heat Resistant Adhesive Designation
Lumber Grade
Accredited Grading Agency
Wood Species or Species Group
Heat Resistant Adhesive Designation
Seasoning or Moisture Content
A.F.P.A® 00
S-P-F NLGA SPS 3 HRA STUD
S-DRY CERT FGR JNT
FOR STUD USE ONLY
Mill Identification
Grading Rules & Special Product Standard Labeling
Lumber Grade
Special Product Standard Labeling

In Canada, the Canadian Lumber Standards Accreditation Board (CLSAB) is the official body that monitors lumber grading and identification, including that for FJL, to ensure that it is properly applied and enforced. Finger-jointed lumber must meet the identical visual grading requirements for a grade in the NLGA Grading Rules as regular solid sawn lumber does.

Grade Stamps

All finger-jointed lumber manufactured to the Canadian NLGA Special Product Standards carries a grade stamp that is similar to the grade stamp found on solid-sawn lumber. The grade stamp on FJL indicates:

- species or species combination identification
- seasoning designation (S-Dry or S-Green)
- registered symbol of the grading agency
- grade
- mill identification
- heat-resistant adhesive (HRA) or non-HRA identification

The grade stamp on FJL also includes the NLGA standard number (SPS 1 or SPS 3), as well as one of two designations: "CERT FGR JNT" (certified finger-joint - conforming to SPS-1) or "CERT FGR JNT – VERT STUD USE ONLY" (certified finger-joint for vertical use only - conforming to SPS-3). Figure 1 provides examples of FJL grade stamps.

Finger-jointed lumber meeting the NLGA SPS 1 or SPS 3 product standards is recognized by the National Building Code of Canada. Sentence 9.23.10.4.(1) Continuity of Studs states that: "Wall studs shall be continuous for the full storey height except at openings and shall not be spliced except by finger- joining with a structural adhesive. (See Appendix A.)"

The Appendix note (Section A-9.23.10.4.(1) Finger jointed Lumber) states, in part that the NLGA Standard Grading Rules for Canadian Lumber" referenced in Article 9.3.2.1. refers to two special product standards, SPS 1, "Finger joined Structural Lumber" and SPS 3, "Finger joined "Vertical Stud Use Only" Lumber" as produced by the NLGA. Material identified as conforming to these standards is considered to meet the code requirements for joining with a structural adhesive. ☼

Letters to the Editor

Re: Thermal Mass (Solplan Review No 144, January 2009)

Under "Thermal Mass Principles," the second sentence states: "In a building, solar energy first heats up the air." I need to correct you on that statement. Solar energy does not first heat up the air. It will heat up any surface or object having low reflectivity, typically a roof, floor, wall, roadway etc.

The most graphic way I have seen this demonstrated is above a wood fence on a sunny, cool day after a rain or heavy dew (or frost). Look above the fence and you will see a stream of vapour coming off the fence. The vapour is steam produced by the solar energy vaporizing the water on the wood, then condensing when it hits the cold air above. Solar energy will heat up the wood much faster than it will heat the air.

Air above the clouds is exposed to a lot of solar energy, yet it never gets very warm. At 30,000 feet altitude, it will be -40°C, while on the ground it may be +40C°.

G.H. Pinch, P.Eng.
Vancouver, BC

Re: Thermal Mass (Solplan Review No 144, January 2009)

I have just read your January issue and, as always, enjoyed it. I have a question arising from a sentence under the heading, "Thermal Mass Principles": "In a building, solar energy first heats up the air."

Are materials not heated by radiation at the same time? Other parts of the article seem to me to infer that materials are heated by solar radiation.

Linden Holmen,
Victoria, BC

Oops. I've learned that we have many sharp-eyed readers, who are prepared to let me know when I've goofed. You are both correct. Solar energy heats up surfaces that see the sun, which is why proper placement of materials to store heat is very important.

Remote thermal storage that is not in the direct sunlight can be used, but it requires more complex design.

Thanks for the correction. Ed.

Ontario Mandates Home Energy Rating

Ontario legislation will require an EnerGuide rating for all new homes for which a permit is issued after January 1, 2010. An EnerGuide rating will be required before any home can be sold after January 1, 2011.

Compliance with the energy audit recommendations will be voluntary – but buyers will be made aware of the condition of the home. This should make it easier for new home builders building more energy efficient homes, as their new homes should rate much better than older homes.

Remembering John Carroll

It's difficult coming terms with the passing of friends and colleagues. It's difficult to have to say adieu. It came as a shock to learn that John Carroll, from Saskatoon, passed away on March 7, 2009.

As a young man John worked as a framer on some of the 14 Low Energy Houses built in 1980 on Christopher Road in Saskatoon and called the Energy Showcase. This group of homes served as a pilot for what became the R-2000 program. He later started his own construction company, and in 1992 he built the Saskatchewan Advanced House, one of the Canadian Advanced Houses. He continued to incorporate the ideas in his work. He also built a custom home for Rob Dumont that until recently was the best insulated house in the world.

John contributed much to the home building industry. He was the Saskatchewan representative on the Technical Research Committee for the Canadian Home Builders Association and also worked on the Part 9 Committee of the National Building Code (Standing Committee on Houses and Small Buildings). He was always ready to contribute to the committees and forcefully represented builder and public interests, yet pressed for practical advanced ideas.

He received the William McCance award from the Canadian Home Builders Association for his contributions to Canadian Housing.

John will be missed in the noble art of house building.

Energy Answers

Rob Dumont

Do any electric utilities charge residential customers more for power usage during peak periods and less during off-peak hours?

Yes. Thirty years ago I was at a meeting in Holland and stayed with friends of my parents. The electric utility there had a two-price system for residential electricity. The friends had an electric meter with two dials. One dial registered electrical usage during the peak periods and a second recorded the off-peak use. I can't remember the difference in price between the two rates but I recall asking the homeowners if the different electricity rates made any difference in how they used electricity. "Definitely" was their answer. They ran their dishwasher and clothes dryer at times when the electricity was cheaper.

Even further back, while I was working in Kenya in the 1960s I noticed that the electric utility there used FM transmitters to control electric water heaters in some homes to control their peak demand. And my sister's home in Bromley, Kent, England in the early 1970s had a similar scheme with a very well insulated domestic water heater that used off-peak power.

The point of all these peak load saving approaches is to reduce the amount of electric equipment that the utility must provide. Airlines and telephone companies also use different rates at certain times to level out their loads.

Canada has been a laggard in the area of shaving peak electrical demand for residences, however some recent initiatives have taken place. Nova Scotia Power now has 6,000 residential customers using peak power meters. While in Halifax in January this year I chatted with a Nova Scotia Power representative who explained the off-peak rates that were available to customers. He mentioned the ABB digital meters they were now using to track consumption at different times of the day, and at different times of the week.

The new meters have three different power rates that they can track. For instance, December, January, and February are the peak months for electricity use in Nova Scotia. During the peak periods of the weekdays, electricity is 15.32¢ per kilowatt-hour and during the off-peak period from 11:00 PM to 7:00 AM the rate is reduced to 6.028¢ per kilowatt-hour. There is a third rate during mid-afternoon which has an intermediate price. An innovative Nova Scotia builder, Steve Crowell, is now incorporating extra thermal storage in his new homes to make use of off-peak power. He incorporates concrete slabs with additional sand and gravel and insulation beneath the slabs.

In Ontario, residential electrical meters are now being changed over to accommodate future time of day rates for electricity. In the United States there is a plan to put 40 million smart electrical meters into homes so that peak power saving can be achieved.

We are finally starting to move toward low greenhouse gas emission electricity sources in Canada with initiatives in the areas of wind, PV, small hydro and biomass. Peak saving electricity rates can make the transition less costly.

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Upcoming Changes to Furnace Standards

Effective December 31, 2009 a new national minimum energy performance standard for residential gas furnaces will go into effect. It will mean that virtually all gas furnaces sold in Canada will have to have a minimum fuel efficiency level of 90%. This level of efficiency is achieved by using well-established "condensing technology" where the products of combustion are vented through a plastic pipe.

Because of the small diameter vent pipe, and relatively cool gases, there are fewer issues about heat and flue chases than is the case with B-vents.

Although the gas code permits combustion gases to be vented through the sidewall of a house, they should still be vented through the roof. Sidewall venting can compromise the house wall because of the moisture load on the wall, and into the attic through soffit vents. In houses on small lots and tightly spaced, a house could create moisture problems for its neighbour.

The new efficiency standard is part of Canada's ongoing efforts to address climate change. Energy efficient furnaces are also cost-effective for consumers. A condensing gas furnace (minimum 90% efficiency) will result in a fuel consumption and cost reduction of about 12% when compared to furnaces at the current standard. The dollar amount will depend on the house size and heat loss.

In the case of renovations and retrofits, the installation may be eligible for an ecoEnergy Retrofit grant from the federal government and complementary provincial program in some parts of the country, as well as the Home Renovation Tax Credit introduced in the 2009 Federal Budget.

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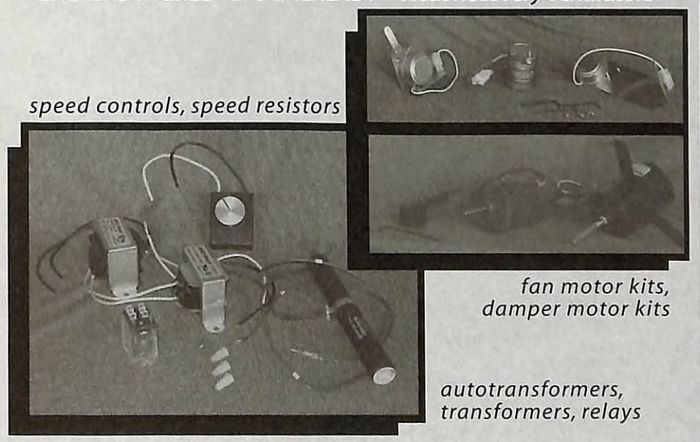

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A Prototype Desiccant-based Evaporative Cooling System For Residential Buildings

By Boualem Ouazia

High indoor humidity levels cause occupant discomfort and increase the likelihood of problems such as mould growth. Air conditioning units or dehumidifiers, the normal mechanical means for reducing humidity levels, use large amounts of electricity and are needed for only a few months of the year. During shoulder seasons, humidity may still be a problem even if cooling is not needed.

One technology that can potentially improve dehumidification performance for residential air-conditioning is desiccant evaporative cooling (DEC). This article describes the characteristics and operation of a prototype DEC system and presents results of tests carried out on a system to assess its performance in term of humidity control and energy efficiency. The tests were carried out in the twin houses (research house and reference house) of the Canadian Centre for Housing Technology. The DEC system was installed in the basement of the research house, while the reference house contained a conventional air conditioning system (exterior unit) used for comparison (control) purposes.

Dr. Boualem Ouazia is a researcher in the Indoor Environment program of the NRC Institute for Research in Construction. Dr. Ouazia can be reached at 613-993-9613 or e-mail: boualem.ouazia@nrc-cnrc.gc.ca

Desiccant-based dehumidification

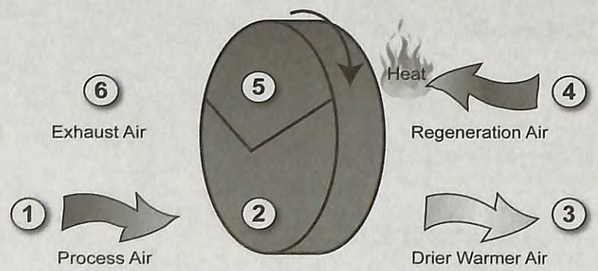
Desiccants are solid or liquid materials that attract moisture. Materials for HVAC desiccation are selected on the basis of their ability to hold large quantities of water, their ability to be reactivated, and their cost. To continually absorb moisture, a desiccant needs to be regenerated (dried) by passing hot air over it. When a desiccant wheel is used, the drying of process air and the regeneration of the desiccant can occur concurrently (Figure 1). For the desiccant wheel used in this experiment, heat was provided by a heating coil supplied by hot water from a gas-fired water heater.

Desiccant evaporative cooling system

The DEC system (Figure 2) used in this study combined active desiccant dehumidification with indirect evaporative cooling. The desiccant wheel was controlled independently using a humidistat that sensed the wet-bulb temperature of the space. A thermostat was used to activate the indirect evaporative cooler when there was a need for space cooling. This arrangement lets the air conditioning (sensible wheel + indirect evaporative cooler) focus on temperature control while the desiccant is directed toward humidity management. One or the other or both may operate, depending on ambient conditions.

Results

The DEC demonstrated better control of relative humidity (lower humidity levels on the second floor and similar on the main floor) throughout the test period. The system did not produce any substantial difference in total moisture content in the house until jumpered – this may be a function of setting the humidistat set-point high. When jumpered, the system proved that it



1 – Humid air enters the rotating bed of dry desiccant
2 – As air passes through the bed, the desiccant attracts moisture from the air
3 – Air leaves the desiccant bed warm and dry.
4 - A second air stream is heated and passed through the desiccant bed to raise its temperature
5 – Heated desiccant gives off its collected moisture to the reactivation air stream coming from the heater
6 – The moist reactivation air is vented outside, carrying excess humidity from the building

Figure 1: Operation of a desiccant dehumidification wheel

was able to reduce humidity to below 40% RH. Testing at a lower humidistat setting would likely better demonstrate this technology's potential and should be recommended for future tests.

The desiccant system consumed large amounts of electricity compared to the air conditioning system in the reference house. This is in part due to inefficient motors, and having to handle its own heat losses. Examining different, more efficient motors such as ECM motors, and locating the system outside the house envelope would help to minimize electrical requirements and shorten run times. The desiccant system consumed large amounts of natural gas for regeneration heat and water for indirect evaporative cooling. An alternate source of heat for the regeneration such as solar could help reduce overall consumption. Water consumption remains a downside to this technology.

Based on the tests, a simulation model was used to generate results for a house with the same characteristics as the Canadian Centre for Housing Technology (CCHT) houses in Calgary, Halifax, Montreal, Ottawa, Saskatoon, Toronto, and Vancouver, using actual weather data. In simulated areas with relatively low sensible heat ratios (humid areas), the desiccant system is expected to be more effective at maintaining comfort levels than the conventional air conditioning system. In areas with high sensible heat ratios (drier areas) the use of the desiccant system with indirect evaporative cooler can potentially increase the total number of hours of discomfort.

Discussion

A desiccant-based evaporative cooling system offers a promising alternative to conventional air-conditioning systems for climates with high latent load (humid climates). Both the experiments and the simulation carried out in the tests described here showed that such a system has significant potential for reducing the uncomfortably high indoor humidity levels that tend to occur in summer in certain regions.

In simulated areas with relatively low sensible heat ratios (humid climates), the desiccant system is expected to be more effective at maintaining comfortable humidity levels than the conventional air conditioning system. In areas with high sensible heat ratios (dry climates) the use of the desiccant system with indirect evaporative coolers can potentially increase the total number of hours of discomfort.

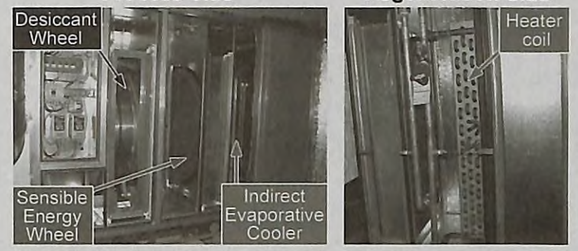


Figure 2: Prototype desiccant evaporative cooling system

Conclusion

Further lab testing is recommended to examine ways to reduce the electricity use of the DEC system. Potential measures include: (1) higher and more stable regeneration temperature; (2) use of more efficient motors such as ECM motors; (3) improvement in the indirect evaporative cooler performance; and (4) minimization or isolation of heat gains from the system components by locating the unit outside the house.

Acknowledgments

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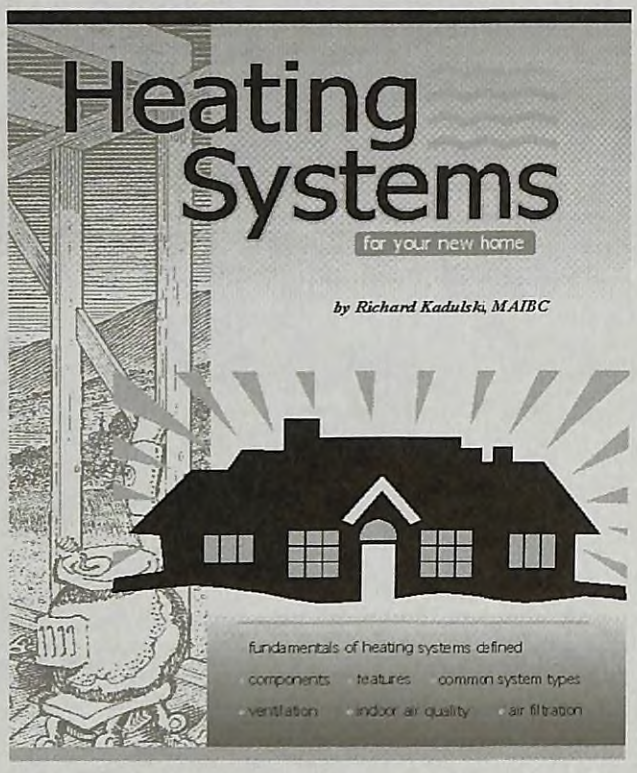
For more information on this emerging technology, visit *http://irc.nrc-cnrc.gc.ca* and enter "desiccant cooling" in the search box. (The project report is currently in review and will be available by the end of March.)

The Canadian Centre for Housing Technology is a facility jointly operated by the National Research Council, Canada Mortgage and Housing Corporation, and Natural Resources Canada.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